



## Annals and Magazine of Natural History

Series 2

ISSN: 0374-5481 (Print) (Online) Journal homepage: http://www.tandfonline.com/loi/tnah08

# XXIX.—On Hydatina senta

### Dr. F. Leydig

To cite this article: Dr. F. Leydig (1857) XXIX.—On Hydatina senta, Annals and Magazine of Natural History, 20:118, 288-297, DOI: 10.1080/00222935709487921

To link to this article: http://dx.doi.org/10.1080/00222935709487921

| <b></b> |  |
|---------|--|
|         |  |
|         |  |
|         |  |

Published online: 26 Oct 2009.



Submit your article to this journal 🕑



Q

View related articles 🗹

Full Terms & Conditions of access and use can be found at http://www.tandfonline.com/action/journalInformation?journalCode=tnah08

#### XXIX.—On Hydatina senta. By Dr. F. LEYDIG\*.

#### [With a Plate.]

WHOEVER has taken notice of the literature of the Rotifera is aware that for a long time the sexual relations of this group of animals were involved in obscurity; for although recent observers were agreed that the parts described by Ehrenberg as testes, seminal ducts, and seminal vesicles, can by no means have any such import, still, on the other hand, no undoubted male sexual organs and seminal corpuscles could be detected.

The discovery of the sexual relations was made by Dalrymple<sup>+</sup>. He proved that Notommata anglica is not hermaphrodite, but that it possesses separate sexes. Subsequently the present writer made known the male of a new species<sup>‡</sup>, nearly allied to the English one; and on comparing the structure of the Rotatoria, with which I had become acquainted by my own observations, with the published statements, I was compelled to conclude, "that male individuals of other species have also been already described, but that they have been described under the title of peculiar genera and species." And amongst other things, I asserted that to my mind it was "beyond all doubt" that the *Enteroplea Hydatina* is the male of *Hydatina senta*.

Unfortunately, I could not at that time meet with this Rotifer in the neighbourhood of Würzburg, although, as many observers state, it is one of the very common and widely distributed species; and this was the more to be regretted, as, in consequence of Ehrenberg's descriptions, the *Hydatina senta* as it were played the part of a typical representative of the Rotatoria in books. Nevertheless I had the satisfaction of seeing my assertion with regard to the male nature of *Enteroplea Hydatina* confirmed by Cohn namely had the opportunity of exaanother observer. mining this animal, and found the testes and motile spermatozoa. During the present spring, in the early part of March, I fished a small pool near Würzburg, which is dry in summer, and there obtained *Hydatina senta* in innumerable multitudes; at that time the animal was almost the sole inhabitant of the water, for besides it I only observed a few *Vorticellæ*, with here and there Towards the end of a Brachionus and some larvæ of Diptera. March they had increased to so extraordinary an extent, that

<sup>\*</sup> Translated from Müller's Archiv, No. 4, June 1857, p. 404. By W. S. Dallas, F.L.S. &c.

<sup>†</sup> Phil. Trans. 1849.

<sup>‡</sup> Ueber den Bau und den syst. Stellung der Räderthiere; Zeitschr. für wiss. Zoologie, 1854.

<sup>§</sup> Zeitschr. für wiss. Zoologie, 1855.



they formed a nearly continuous greyish-white stratum close to the surface of the water. The *Enteroplea*, which at first occurred rather sparingly, had then also become so numerous, that perhaps one *Enteroplea* might be counted to every twenty or thirty *Hydatinæ*. I studied the animalcule closely, and as my results do not agree in all points with Cohn's, it may not be superfluous to give some details of the structure of *Hydatina* and *Enteroplea*.

It is incorrect when the above-mentioned author says that Hydatina senta "is one of the largest Rotatoria:" it is rather only one of middle size, for many other species, such as Notommata myrmelco, and especially Notommata Sieboldii, exceed it three, four, and five times in size. That naturalist, indeed, well remarks, that the form of the animal in its true outlines can only be recognized when it is swimming about freely in a sufficient quantity of water; but neither the figure nor the description given by him of the form of Hydatina can be indicated as true; his figure of the rotatory organ especially departs far more from nature than that given by Ehrenberg, for which reason I consider it necessary to publish a new representation of it.

As regards the form of the animal, we perceive in individuals which are swimming about quictly, revolving upon their axis, that the body is divided into three principal parts,—a cephalothorax, an abdomen, and a tail. If we disregard the abdominal notch, the cephalothorax appears to be distinguished from the abdomen, especially on the dorsal surface, by a tubercular inflation, upon which the single setigerous pit (Borstengrube), beneath which nerves terminate, is situated. This tubercle of the cephalothorax, however, only makes its appearance distinctly when the stomach is not exceedingly full, or the ovary is not too much developed : when either of these circumstances occurs, the tubercle must of course disappear more or less in consequence of the The first or anterior third of the inflation of the abdomen. cephalothorax is separated as the head by a sharp furrow. The abdomen, which is faintly annulated, ceases with the segment which bears the cloacal orifice; then follow the segments of the tail, of which even the first is narrower than the last segment of The tail diminishes rapidly, and runs out into a the abdomen. didactyle foot.

The margin of the head or rotatory organ (Pl. VIII. fig. 1) is not simple, but distinctly formed of two lips, with a tolerably deep furrow between them. On the dorsal surface this furrow rises into a papilliform process, lying in the median line, corresponding to which the inner lip of the rotatory organ also gives rise to a prominence; the surface of the rotatory organ bounded by the inner lip sinks into a funnel-shaped depression or buccal cavity. As regards the ciliary coat, we may easily distinguish a Ann. & Mag. N. Hist. Ser. 2. Vol. xx. 19 border consisting of fine long hairs, which runs uninterruptedly round the rotatory organ and belongs to its outer edge. The hairs strike outwards. Perceptibly different from these, are some strong or bristle-like cilia, which stand next to them on the inner lip of the rotatory organ, and also form a continuous series; similar bristles also fringe the true margin of the buccal cavity, which lies further inwards; and even between the two series of bristles above indicated, cilia, of equal strength and irregularly distributed, are seen working; lastly, the two papilliform processes previously mentioned also bear a tuft of about six bristles. All the thick, bristle-like cilia strike like hooks inwards.

The ceaseless movements of the animal, and the constant inversion and eversion of the cephalic extremity, add not a little to the difficulty of observing it; and in order to convince oneself of the true form of the rotatory organ, it is advisable to kill the animal slowly, and without its inverting itself. For this purpose I made use of an extremely weak solution of bichromate of potash, in which they continued to swim about for hours, and remained extended after death. That a covering glass is not to be used in examining them, is a matter of course.

The external integument (Pl. VIII. fig. 2), as has been shown to be the case in other Rotatoria, consists of two different layers, namely of the external structureless cuticula, and the "granular layer" situated beneath this. I should not have considered this worth mentioning, had not Cohn said that the granular layer described by me is scarcely to be distinguished as such in mature individuals of *Hydatina*. Both in fresh objects and in animals which have been acted upon by acetic acid, the separate nuclei of the soft cutaneous layer in question may be seen as clearly as can be desired, and in many individuals single fatty points lie in this cutaneous stratum.

With regard to the muscles, it may be stated, that besides the longitudinal and annular muscles, of which the former are the broadest, and also exhibit a differentiation into a clear cortical, and granular axial substance (Pl. VIII. figs. 1 & 2, b), there are also branched muscles, and that not only in the head, where they are especially striking, but also in every segment of the body. In the broad, longitudinal muscles (figs. 1 & 2) the granules of the axial substance are sometimes observed to be very regularly arranged, so as to remind one of a delicately-marked transverse striation. Cohn's statement, that the substance of the muscles sometimes "appeared frothy from vacuoles," can only refer to altered or dead muscles.

Of the *brain* and the *nerves* radiating therefrom, I thought I might also give a new figure (Pl. VIII. fig. 2, c): this organ, when seen from above, is nearly quadrangular; when

seen in profile, it presents a tolerably strong convexity above. To the single pit with the tuft of bristles two strong nerves pass; two other filaments also go to it; these are of a muscular nature, and I certainly saw them contract. These are the filaments which Cohn describes as "going to the same spot in the neck from other centres of the nervous system." The substance of the fresh brain exhibits small nuclei, imbedded in a homogeneous fundamental mass, in which there are also still more distinct molecules. The "large, circular, limpid vesicle, apparently a vacuole, very frequently observed" by Cohn, is, in my opinion, a product of decomposition; such appearances readily appear in the delicate tissues of the lower animals, when their vital activity is diminishing.

I shall pass over the alimentary apparatus, as it has the same structure which has been described by me in detail in other Rotatoria, whose alimentary system is divided into pharynx, esophagus, stomach and intestine; only, with regard to the pharynx, I may add, that the apparently beautiful cells, which we think we see in the fleshy parts (see fig. 1, a), are the transverse sections of muscles, and, indeed, of such muscles the substance of which is separated into a homogeneous cortical layer and a granular axis; this, therefore, is the reason why, on close examination of these apparent cells, we perceive that they have a clear, distinctly marked, peripheric layer, and internally a granular mass of contents, from which a limpid nucleus glimmers\*.

With reference to the "respiratory system," I am again under the necessity of declining the corrections which Cohn has bestowed upon my statement. I had stated (l. c. sup.) that the so-called tremulous organs (Zitterorgane) in their form represented two types, which, however, do not occur in one and the same animal, but show themselves to be distributed in different Thus some remain as cylindrical tubes, of uniform genera. width, --- such are possessed, for example, by Notommata myrmeleo; others are dilated at the free extremity, and thereby acquire a somewhat trumpet-like form, as in Notommata centrura, Euchlanis triquetra, Eosphora najas. Cohn, however, asserts, "that one and the same tremulous organ presents one or the other form according to its position," and in support of this, cites the figure of Notommata centrura, in which both forms are to be seen. But our author here evidently misunderstands the figures, for

<sup>\*</sup> In opposition to Cohn's statement that there is ciliary movement in the œsophagus of *Brachionus*, I adhere to my previous assertion, that the œsophagus of the Rotatoria is never clothed with cilia; in *Brachionus* the œsophagus is very short, and Cohn has erroneously transferred the strong ciliation at the commencement of the stomach into the œsophagus.

what he regards as cylindrical tremulous organs are trumpetshaped ones seen in longitudinal section; from their flat nature, they then appear cylindrical. When Cohn becomes acquainted with true cylindrical, uniform tubes, such as occur, for example, in *Notommata Sieboldii*, he will perceive the difference of form between the two.

The fluid which fills the abdominal cavity, washes the viscera, and forms the analogue of the *blood*, in individuals which had been plentifully fed with *Euglena viridis*, contained numerous clear globules, or blood-corpuscles, of a roundish form and unequal size. It was remarkable to meet again in *Hydatina senta* with the same structures which I had formerly, as a matter of supposition, attempted to indicate in Lacinularia as spermatozoa\*, and afterwards arranged in the series of parasitic formations. They are globular bodies with sharp outlines; their margin is furry, as if with a fine coat of hair. Towards the end of March the entire abdominal cavity of many individuals was so filled with these globules, that the animal appeared strongly white by reflected light. However, the individuals thus affected swam about just as briskly as those which exhibited nothing of the sort.

The *clavate bodies* in the tail consist of a delicate envelope and pale molecular contents, in which beautiful nuclei, each with a nucleolus, may be distinguished; in many individuals, small fatty points are also present in variable amount. I regard the organs in question as glands, which in their position and function correspond with the caudal glands of *Enoplus* for example +; they open at the apex of the caudal appendages (Fusszangen); and as the worm just mentioned "can attach itself firmly to the object-bearer by the posterior extremity of the body, in order to carry the body round this point with a waving motion," so also can the Hydatina fix itself by the tips of the caudal appendages, probably by means of the sticky substance excreted here. It seems to me also that in a certain upright position of the caudal appendages, I have detected the opening at their tip.

The hairy coat of the "winter eggs," which Ehrenberg, in opposition to R. Wagner, declared to be an Alga, *Hygrocrocis* vestiens, is distinctly perceptible even on the eggs in the ovary.

The male Hydatina, or the Enteroplea Hydatina of Ehrenberg (Pl.VIII. fig. 3), is certainly considerably smaller than the female, but has the same outline of body, and even the rotatory organ is notched on the ventral side, as in Hydatina senta. This structure is seen with certainty in animals which tumble about freely without being annoyed by a glass cover, and thus turn their rotatory organs to the beholder from all sides. Cohn erroneously

<sup>\*</sup> Zeitschr. für wiss. Zool. 1851.

<sup>†</sup> Müller's Archiv, 1854, tab. 11. fig. 12.

asserts that the obliquely funnel-shaped depression of the rotatory organ is wanting in the male. In animals which begin to tire in their movements, we may perceive, with regard to the form of the body, that the dorsal surface is somewhat arched, and the ventral rather flat; perfectly fresh individuals are continually contracting, and the body thus appears strongly folded longitudinally.

The muscles, the brain with the nerves, the contractile vesicle with the vessels and tremulous organs, are essentially as in the female, for which reason they will not be further mentioned; I refer the reader to fig. 3. The clavate glands in the tail also are not wanting; but this difference is perceptible—they are faintly notched several times on the margin, which is not the case in the female.

Dalrymple had observed in Notommata anglica, as I have done in N. Sieboldii, that the male is entirely destitute of an alimentary The male animals possessed neither pharynx nor jaws, canal. cesophagus nor stomach. There was only an irregular aggregation of cells, which was regarded as the rudiment of the aliment-Of the male *Hydatina* also Cohn states, that in it (the ary canal. *Enteroplea*) the nutritive apparatus is completely wanting in all its parts, and that not even the cellular rudiments of the abovementioned species of *Notommata* are to be detected. With this view, however, I cannot altogether agree. It is true that, as was already established by Ehrenberg, the *Enteroplea* is entirely destitute of biting organs, and a developed tractus cibarius is altogether wanting; moreover, no solid nourishment taken from without is ever observed in the transparent animal. But it may be said with perfect certainty, that the alimentary canal exists in Thus, the part which Cohn has characterized an abortive state. as the suspensor testis, and Ehrenberg as the intestine, and which the former author regards as a long and broad band, originating from the anterior apex of the testis, and running transversely through the cavity of the body towards the frontal region, is undoubtedly a rudiment of the alimentary tube (Pl.VIII.fig.3, a), as is shown both by its position and structure. When the animal is examined in profile, the anterior extremity of the rudimentary intestine passes exactly towards that spot in the rotatory organ where the buccal orifice is situated in the female; posteriorly, as will be mentioned immediately, it extends to the cloacal orifice. As regards its more intimate conditions, we find the rudimentary intestine, like other organs which have become retrograde, more or less abortive in different individuals; sometimes it is a clear, folded tube, without cellular parts ; in another case it contains unmistakeable remains of the stomachal cells namely large vesicles, with aggregations of such yellowish-brown bodies as fill the stomachal cells of all Rotatoria,—thus furnishing a distinct indication of its nature.

In order to trace the further relations of the rudimentary intestinal canal, regard must at the same time be had to the *testis*, This which is situated in the hinder section of the abdomen. organ (Pl. VIII. figs. 3, 4, c, c) forms an oval sac, the walls of which are, however, by no means, as Cohn describes them, "very thick and muscular," but, on the contrary, formed of a thin membrane. What the naturalist just mentioned calls the "very thick and muscular walls" is the continuation of the rudimentary intestine : we see this soldered to the testis, and by this means an apparent second envelope of the organ is produced. Some band-like filaments pass from this envelope to the skin for the purpose of attachment. They are, however, no more contractile (here also Cohn makes an opposite assertion) than the The entire rudimentary stomach which surrounds the testis. testis itself and its contents, as well as the efferent duct and its accessory glands, display the greatest similarity with what I have described in Notommata Sieboldii, only that everything, down to the parts of the tissue, is smaller in Enteroplea. The spermatozoa (fig. 5), as in Notommata, are of two kinds: some have a bacillar form, exhibit no movements, and are stiff; the others consist of a body pointed before and behind, upon which an undulating membranc rises like a crest. In many individuals all the spermatozoa, so long as they were enclosed in the testis, remained quict, and only began to move when they were pressed out and brought in contact with water; then, however, the movement became slower, and soon stopped altogether. Another time the spermatozoa exhibited a swarming movement even within the testis.

Perhaps the spermatozoa undergo a further development within the body of the female as soon as they are transferred there by copulation; at least, it is remarkable to me that the seminal elements moving about in the abdominal cavity of certain females were much thicker at one end, and as it were had a separated head, which was never seen in those pressed out of the testis. In exact accordance with what was observed in Notommata, the motionless, bacillar spermatozoa lie in the testis, especially at the point where the efferent duct commences, and by their regular arrangement produce a radiate striction at this point. I must directly contradict the statement that this "close, parallel, longitudinal striation" occurring at the posterior end of the testis, is due to "muscular fibres;" the "striæ" may be pressed out as well as the rest of the contents of the testis; and in this way we may convince ourselves that the bacillar spermatozoa were the cause of the striation. The wall of the testis, as has been already mentioned, is destitute of contractility; but it may be observed that the efferent duct is capable of strong contractions, and I also refer its thick wall and the transverse striation visible on the latter, to a muscular membrane. Cilia exist in the interior of the duct; they are longest at the orifice, and the latter is situated on the first segment of the tail. On the outside of the efferent duct there are some glandular bodies, which might be compared with accessory glands, perhaps a prostate, as was also done with regard to *Notommata*.

The same dark aggregations of granules (Pl. VIII. figs. 3, 4, b) which are observed in many embryos and young animals of the Rotatoria occur in Enteroplea; they usually form two masses, but sometimes three; the granules vary greatly in number and size, and sometimes we see accumulations of small globules; sometimes they consist of a few single, large fragments. From their optical and chemical characters, I had pronounced these granules to be uric concretions, and expressed the opinion that such accumulations of granules or crystalline formations occurring, except in the males, only in the embryonic stage and in early youth, might have the signification of a primordial kidney. Cohn, on the contrary, thinks that "this whole hypothesis falls with the proof that in Enteroplea the vesicle with the dark granules stands in no sort of connexion with the intestine, nor indeed can do so, as no intestine exists, and that it is rather firmly adherent to the outer wall of the testis, which I could prove beyond a doubt." And yet I cannot avoid remarking that, as is evident from the above description of the testis, Cohn's "undoubted proof" is an error. For the clear space containing the dark granules is not "adherent" to the true wall of the testis, but to that outer envelope which represents the rudimentary stomach and intestine; or, more properly speaking, the clear space enclosing the concretions belongs to the abortive alimentary canal itself, which extends from the notch of the rotatory organ to the cloacal opening; so that Enteroplea displays the same characters as the other Rotatoria, although this is in complete opposition to the description given My opinion that the granules in question are uric by Cohn. concretions, is of course no more strongly supported by the position of matters detected in Enteroplea than before, but the objection raised by Cohn appears to be removed. The opinion first put forward by Weisse, which is also favoured by Cohn, that the granules are the remains of unused yelk-masses, I must reject, without taking other reasons into account, if only because the vitelline clements and the granules in question have no resemblance to each other, but are perfectly different things.

In conclusion, something may be stated regarding a parasite

living in the stomach of the female Hydatina, which appears to be hitherto undescribed, and may be referred to Ehrenberg's family of the Astasiæa. The parasite was so plentiful, that nearly every Hydatina, out of hundreds that were examined, had at least one in its interior; nay, it was found that very young individuals, of which the stomach was still colourless, harboured as many as five or six of these creatures. If it should be supposed that it might be a pseudo-parasite, which forms some part of the nourishment received, an idea which may occur at first, this is contradicted by the fact that the animalcule is never met with in a condition which indicates, even to a certain extent, that, like other swallowed animals, such as Euglenæ, it is subject to the digestive power of the stomach; it is rather found always uninjured, and in most powerful movement.

Our animalcule (Pl.VIII. fig.6) is of the size of Euglena viridis, and has considerable resemblance to it in form; but it appears to be most nearly allied to the Distigma tenax of Ehrenberg (Proteus tenax of Müller and Schrank). The foundation of its body is formed by a soft, gelatinous substance, from which no proper cortical layer or skin has separated. In the interior there are numerous globules, of a fatty lustre, of various sizes, and not of a simple round form, but which appear sometimes stratified, sometimes as if pierced by an orifice, and sometimes repeatedly divided; many look as if they had undergone segmentation into four portions. After pressure with the glass cover, they acquire a tolerably intense indigo-blue colour. In consequence of these bodies, which resemble fat-drops, the parasite appears very white by reflected light. Moreover, towards the anterior extremity of the body, two clear, nucleus-like bodies are distinguished, and these again display a more opake spot. Lastly, a reddish point, or "eye-spot," which has a sharply circumscribed form, is situated quite in front. The movements of the animal are very lively, especially when the stomach of the Hydatina begins to make unusual contractions on the occurrence of any deficiency of water; it then endeavours to escape from the intestine, and if it succeed in this, it hurries away therefrom in great haste by its peristaltic contractions. The animalcule swells up, and constricts itself from before backwards, in a manner analogous to that in which, in the contractions of the muscles of the lower animals, a thickened space is often seen to pass in an undulating manner along the muscle.

#### EXPLANATION OF PLATE VIII.

[All the figures magnified about 300 diameters.]

Fig. 1. The head of the female Hydatina from below, to show the form of the rotatory organ: a, the pharynx, should be represented further forward nearer to the buccal orifice; b, b, muscles.

- Fig. 2. Head of a somewhat smaller animal, from above : a, pharynx; b, muscles; c, brain; d, "respiratory tubes."
- Fig. 3. Male Hydatina (Enteroplea Hydatina): a, the rudimentary intestinal canal, to which the dark aggregations of granules, b, belong ; c, testis.
- Fig. 4. The hinder extremity of an Enteroplea, exactly in a lateral position : a, remains of the tractus;  $\bar{b}$ , the aggregations of granules ("uric concretions"); c, testis; d, efferent ducts; e, "prostate."
- Fig. 5. Spermatozoa of Enteroplea: a, stiff, bacillar form; b, form furnished with an undulating membrane.
- Fig. 6. The animal living in the stomach of the female Hydatina. It is represented in its various stages of contraction.

#### PROCEEDINGS OF LEARNED SOCIETIES.

#### ROYAL SOCIETY.

June 18, 1857.-The Lord Wrottesley, President, in the Chair.

"On the Development of Carcinus Mænas." By Spence Bate, Esq., F.L.S.

The author, after noticing the history of the subject, and the opposition which the assertion, "that the Zoëa of naturalists is the larva of a common crab," received, traces the progress of the development of the animal from the Zoëa to the adult, and endeavours to demonstrate, that from the youngest to the most perfect form, the changes are the result of no sudden transformation, but produced by a gradual series of alterations contemporary with every succeeding moult; that the Zoëa is connected with the Megalopa, and the latter with the adult by many intermediate gradations, each in itself scarcely appreciable, and progressively approximating more and more nearly to the more perfect stages.

The author asserts that the development is earliest and most complete anteriorly; that when first born, the seventh or posterior segment of the head, one or more of the posterior segments of the pereion (thorax), and the penultimate of the pleon (abdomen) are wanting in the brachyurous Decapods; but that this general law loses somewhat of its force in the descending scale of development; and as it becomes less persistent, the animal approximates in the larval condition nearer to the form of the adult type; while on the other hand, the same appears to be a constant law of the depreciation in adult forms, as exhibited in the more or less aberrant Amphipoda, such as Cyrtophium, Dulichia, &c. The author likewise shows that the appendages, which act the principal parts in the larvæ, become the secondary parts of the same organs in the perfect animal. For instance, the lower antenna is represented in the larva by the complementary appendage of the adult form; the true antenna is developed from the base of the embryonic organ, which represents

297